

MARKSCHEME

MAY 2006

BIOLOGY

Higher Level

Paper 2

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SECTION A

1. (a) $2.4 (\pm 0.1) \text{ ml O}_2 \text{ g}^{-1} \text{ h}^{-1}$ (*units required*) [1]
- (b) as temperature rises oxygen consumption decreases / negative correlation / inverse proportion (from 6°C to $30\text{-}32^\circ\text{C}$);
but fairly stable/little effect above $31(\pm 1)^\circ\text{C}$; (*units required*) [2]
- (c) temperature below which animals' oxygen consumption increases / temperature below which animals respiration rate increases (to maintain body temperatures);
temperature at which animal reaches minimal oxygen consumption / temperature above which oxygen consumption remains steady / possible increase; [1 max]
- (d) (i) sloth [1]
- (ii) e.g. at 17°C has 100% of metabolic rate and at -20°C has $280(\pm 5)\%$ (of metabolic rate) / a change in 37°C corresponds to a change of $180(\pm 5)\%$ (of metabolic rate);
 $180 \div 37 = 4.9(\pm 0.2)\%$ (of metabolic rate) per degree of temperature change/ $^\circ\text{C}^{-1}$; [2 max]
Award full marks for correct calculation of slope using other figures.
Award [1] in case of ECF of a correct calculation with incorrect figures.
- (e) to produce heat;
maintain constant body temperature; [1 max]
- (f) tropical mammals have a greater increase in metabolic rate as the temperature drops / arctic mammals have a (more) gradual change in metabolic rate as temperature drops;
tropical mammals have a higher lower critical temperature;
values for arctic mammals are extrapolated/estimated/not proven/less certain;
tropical mammals are not (as well) adapted to cold temperatures / they live where little temperature change occurs;
arctic mammals have more/thicker fur/more insulation to help keep warm;
tropical mammals use BMR to regulate temperature more than arctic mammals; [3 max]
- (g) (i) $65.0 - 32.5 = 32.5(\pm 0.5) \text{ mm}$ (*units required*) [1]
- (ii) the values for thickness are only of length and not the density / number of hairs per surface area (that could be greater in the reindeer);
does not include thickness of each hair (that could be greater in the reindeer) / different compositions/materials;
does not include amount of air trapped in fur for insulation (that could be greater in the reindeer);
different colours of hair affect absorption light energy; [1 max]

- (h) (i) beaver drops by about $1.9(\pm 0.1) \text{ W dm}^{-2}$ / from $2.05(\pm 0.05) \text{ W dm}^{-2}$ to about $0.20(\pm 0.05) \text{ W dm}^{-2}$ (*units required*) **[1]**
- (ii) increase in metabolic rate (to generate heat);
fat insulation (to maintain heat);
fast muscle movements (to generate heat);
vasoconstriction/decreased blood flow to surface; **[1 max]**
Accept any other reasonable suggestion.
- (i) (increases in) both are adaptations to maintain body temperature;
mammals are homeotherms / must maintain constant body temperature;
increased metabolic rate produces more energy to maintain body temperatures;
thicker the fur, the greater the insulation value;
animals with high fur thickness do not change BMR as quickly as animals with lower fur thickness;
examples of animals with greater fur thickness and lower critical temperatures;
greater fur thickness, less need for increased metabolic rate to maintain temperature /
less fur thickness requires higher metabolic rate to maintain body temperature;
thicker fur saves energy stores during cold temperatures when food is scarce;
animals in two data sets are not identical / insufficient data; **[3 max]**

2. (a) (i) use of data to give a valid argument why it is dominant;
e.g. not (likely to be) recessive because no instance of offspring without a parent with the phenotype / if recessive, I-2, II-1 and II-8 would all need to be carriers (which is unlikely);
- (ii) use of data to give a valid argument why it is not sex-linked;
e.g. males and females both affected / not X-linked because I-1 could not produce a male child with the disease; [2 max]
- (b) (i) III-1: fhfh and III-2: FHfh; (or equivalent) [1]
- (ii) 0.5 / 50%; [1]
- (c) 100% (as has FH allele) / high probability; [1]

3. (a) Award [1] for each correct structure **and** its role.

	Structure	Role
I:	mitochondria	produce ATP/site of (aerobic) respiration;
II:	nucleus	contains genetic information/produces RNA / site of replication;
III:	(rough) endoplasmic reticulum	(site of) translation/protein production/protein transport;

[3]

- (b) (i) A in nucleus / A in mitochondria [1]
- (ii) B in a mitochondrion [1]
- (c) (i) insulin / glucagon [1]
Do not accept proteins.
- (ii) vesicles formed at/bud off from RER;
product carried to Golgi apparatus (and modified there);
vesicles carry product to plasma membrane;
fuse with membrane;
release product (to lumen) / exocytosis;
ATP used / energy required; [3 max]

SECTION B

Remember, up to TWO “quality of construction” marks per essay.

4. (a) sepal;
petal;
anther;
filament;
stigma;
style;
ovary; **[4 max]**
Award [1] for each structure accurately drawn and correctly labeled.
- (b) *transport: [3 max]*
water transported in xylem vessels;
transpiration pull;
due to loss of water vapour from leaves (and stems) / evaporation of water from leaves;
cohesion of water molecules (due to hydrogen bonds) / continuous column of water;
capillarity/adhesion;
transpiration stream is flow of water within the plant;
transpiration stream is flow of water from roots through the plant;
abiotic factors: [3 max] (accept inverse statements)
light: in day guard cells are open so increases evaporation and transport of water;
temperature: higher temperatures increase evaporation and transport of water;
wind: more wind, faster evaporation and increase transport;
humidity: higher humidity in air decreases (rate of transpiration) and transport;
CO₂ concentration: if high, stomata close and lower transpiration rate; **[6 max]**
- (c) chemiosmosis is synthesis of ATP coupled to electron transport and proton movement;
photophosphorylation is the production of ATP with energy from light;
light energy causes photolysis/splitting of water;
electrons energized (from chlorophyll)/photoactivation;
photolysis provides (replacement) electrons for those lost from excited chlorophyll;
photolysis provides protons/ H⁺ (for thylakoid gradient);
electron transport (carriers on membrane of thylakoid);
causes pumping of protons/ H⁺ across thylakoid membrane/into thylakoid space;
protons/ H⁺ accumulate in thylakoid space /proton gradient set up;
protons/ H⁺ move down concentration gradient;
into stroma;
flow through ATPase/synthetase;
leading to ATP formation; **[8 max]**

(Plus up to [2] for quality)

5. (a) *Award [1] for each structure accurately drawn and correctly labeled.*
haploid nucleus;
 (two) centrioles;
 cytoplasm (must show large volume relative to nucleus – suggest four to one ratio of diameter at a minimum);
 (first) polar cell / polar body (needs to be drawn on the outside of the cell);
 plasma membrane;
 follicle cells / corona radiata;
 cortical granules (need to be drawn in vicinity of plasma membrane);
 zona pellucida;

[4 max]

- (b) *Award [1] for each of the following pairs up to [6 max].*

Mitosis	Meiosis
one cell division	two divisions / reduction division;
chromosome number does not change (do not award mark for diploid cells produced as mitosis can occur in haploid cells)	converts diploid to haploid cells;
products genetically identical	products genetically diverse;
separation of sister chromatids in anaphase	separation of homologous chromosomes in anaphase I and sister chromatids in anaphase II;
no crossing over	crossing over in prophase I;
no formation of tetrads / no synapsis	formation of tetrads / synapsis;
produce cells for growth / tissue repairs / asexual reproduction	produce sexual cells / gametes for sexual reproduction;
two cells produced	four cells produced;
daughter cells with both copies of chromosomes/random assortment does not occur;	random assortment of maternal / paternal chromosomes (provides genetic diversity);
replication of DNA in interphase	replication in interphase I;
four phases: prophase, metaphase, anaphase, telophase	same four phases twice;

[6 max]

- (c) crossing over (in prophase I);
new combinations/recombination/exchange of alleles;
non-disjunction / chromosomal mutation can occur creating new varieties;
genetic mutations can occur creating new varieties;
random alignment of homologous chromosomes at metaphase I / independent assortment;
variety of chromosomes set $2^n / 2^{23}$ (in humans);
random mating in population creates new genetic combinations;
random fertilization of one sperm with one egg;
variations allow for better chances for survival / better adaptation;
more likely to survive to reproductive age;
variation allows a population to survive environmental change;

[8 max]

(Plus up to [2] for quality)

6. (a) *Award [1] for each of the following clearly drawn and correctly labelled.*
 relative position of atoms correctly shown;
 individual amino acids labeled;
 peptide linkage labeled correctly;
 NH₂ at one end and COOH group at other / NH₃⁺ and COO⁻;
 R group coming off the alpha carbon in each amino acid; **[4 max]**
- (b) mRNA carries copy of DNA / gene;
 binds to ribosomes (in cytoplasm);
 codons of mRNA pair with anticodons / complementary base pairing of tRNA;
 3' end with CCA for attaching specific amino acid;
 some amino acids have more than one tRNA / degeneracy;
 tRNA activating enzymes bind a specific amino acid to tRNA;
 two tRNAs bind to ribosome;
 one holds the growing polypeptide;
 amino acids bonded by peptide linkage;
 after peptide is transferred, one tRNA is released;
 ribosome shifts position;
 translation consists of initiation, elongation and termination;
 occurs in 5' to 3' direction;
 start and stop codons;
 polysomes / group of ribosomes may translate one mRNA at once; **[8 max]**
- (c) *definition: [4 max]*
 homeostasis maintains the internal environment at a constant level / between narrow limits;
 involves monitoring levels of variables;
 correcting change with negative feedback;
 variables affecting enzyme function are under homeostatic control;
examples: [4 max]
Award [2 max] for outlining each example of homeostatic role in enzyme function. Award marks for other suitable examples not outlined below.
 pH is under homeostatic control;
 e.g. proteases optimal activity at 1.5 / acidic pH;
 hunger/eating affects substrate concentration;
 e.g. while eating starch, more activity of salivary amylase to digest starch;
 control of excess substances in storage / condensed form;
 e.g. glucose condensed to glycogen (by specific enzyme in liver);
 negative feedback keeps substrate/product levels within range;
 e.g. ATP inhibition of phosphofructokinase in glycolysis;
 temperature controlled to avoid denaturing enzymes; **[6 max]**

(Plus up to [2] for quality)

7. (a) *Award [1] for every two linkages correctly shown. Award [3 max] if fewer than eight organisms are correctly named. Deduct [1 max] for arrows in the wrong direction. Reject responses that state plant, grass, bird, insect or other broad groups of organisms. Acceptable examples maple, egret, trout, marine iguana, Biston betularia. Deduct [1 max] if organisms are unlikely to encounter one another in their habitat. Deduct [1 max] if any chain does not have a producer/ source of organic material.* **[4 max]**
- (b) surplus amino acids are degraded to nitrogenous compounds;
freshwater fish excrete/produce ammonia;
toxic, but diluted by abundant water;
birds fly and need to be light / little water;
birds excrete uric acid;
have little water and uric acid is insoluble and non-toxic;
birds and mammals can live in dry habitats and need little water to excrete N-products / water conservation;
mammals excrete urea;
soluble in blood, (relatively) non-toxic (and excreted in the kidneys);
trade-off between energy conservation and water conservation; **[6 max]**
- (c) *general statements: [3 max]*
vaccinations stimulate antibody production / immunity;
against/resistance to specific pathogens / artificial immunity;
use either weakened pathogens or specific antibodies;
primary response to first vaccination / secondary response to second vaccination;
memory cells (are cloned) maintain long-term immunity;

benefits: [3 max]
eradicated some diseases e.g. smallpox / polio;
decrease child mortality;
MMR/mumps, measles and rubella prevent long-term health problems;
e.g. deafness / blindness / heart damage from rubella / male infertility from mumps;
prevent epidemics / pandemics;

dangers: [3 max]
too many vaccinations may lower body's immunity to new diseases;
immunity may not be life-long / may have severe version as adults e.g. measles;
some vaccines may cause serious side effects;
e.g. whooping cough vaccine may cause encephalitis / toxic effects (Hg) in some vaccines / allergic reactions;
may contract disease from vaccine; **[8 max]**
Examiners are encouraged to identify where marks are being awarded from, i.e. the general statements, benefits statements or dangers statements.

(Plus up to [2] for quality)